THE ROLE OF FORESTRY IN AGRICULTURE AND FOOD SECURITY

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ABSTRACT

The whole question of the contribution of forestry and trees to the sustainability of agriculture and food security is one that has not received adequate attention. Rather, forest lands are still treated mainly as a nuisance to be eliminated in order to expand croplands. To bridge this knowledge gap and ensure that the role of forestry is given due consideration in discussion of food security in Nigeria, an attempt was made in this paper to highlight some of the ways forests and trees contributes in ensuring the sustainability of agricultural production and ultimately in the promotion of food security. These contributions range from their protective environmental functions such as the maintenances and restoration of soil fertility, erosion control and biodiversity maintenances to direct food production, provision of fuel wood, fodder and inputs for agriculture as well as the generation of income and creation of rural employment. These either enhance agricultural production and food availability or increase the ability of people to purchase adequate food supplies. The paper therefore suggests that instead of the false dichotomy that has existed between forestry and agriculture, experts from these disciplines need to work hand-in-hand in the fight against hunger and malnutrition.

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INTRODUCTION

Forest lands are often seen as areas that needed to be cleared to create space for the growing of agricultural crops. As competitors for sunlight, water and soil nutrients and as providers of homes for birds, insects and other enemies of the farmer, the presence of tree is often seen as

inimical to agricultural production. Little heed has been paid to the beneficial influence of forests even less to the possibility of integrating trees with the production of crops, livestock or a mixture of both in farming systems. The realization that trees can improve agricultural production and the development of farming systems that take advantage of this are still far from being widespread. The result has been the wanton destruction of forests and trees with their negative consequences on food production in particular and environmental degradation in general. The present discussion is therefore aimed at highlighting the various ways forestry contributes in ensuring sustainable agricultural production and food security - defined as a condition in which '*all people at all times have both physical and economic access to be basic food they need'*.

Contributions of forestry to sustainable agriculture and food security

Forestry contributes in myriad of ways to sustainable agricultural production and food security. The greatest contribution is through its protective environmental functions such as the maintenance and restoration of soil fertility and soil improvement, erosion control and maintenance of biodiversity. Forestry also contributes in many other ways such as through the direct production of food, provision of rural employment and income. A detailed discussion of these contributions is made below.

i Maintenance and restoration of soil fertility and soil improvement.

When soil becomes poor in plant nutrients, food production is impaired. In other words, continued agricultural production is dependent on the fertility of the land. But continued crop production on a piece of land leads to the depletion of soil nutrients which translate into poor yield. However, maintenance of forest cover on the land helps in restoring soil fertility hence resulting to increased yield of agricultural crops. Trees improve soils by many processes the most important of which are organic matter maintenance, nitrogen fixation, nutrient recycling and augmentation of nutrient uptake. The inclusion of trees in land use systems can augment the supply of plant material to the soil, as above ground litter and pruning deposits and more importantly by the shedding of fine roots. Many tropical species of trees belong to the family of leguminosae whose roots harbor bacteria that enable nitrogen to be fixed from the atmosphere. As many as 600 different tree species (not only leguminous ones) are known to be able to fix

atmospheric nitrogen. In the humid tropics for example, it has been estimated that *Leucaena leucocephala* fixes an annual average of 500kg of nitrogen per hectare and *Casuarina littoralis* 218 kg (FAO 1985a). The greatest potential contribution of fertility maintenance lies in the capacity of root system from trees to recycle plant nutrients that would otherwise be lost in leaching. Due to their sheer size, trees have a major role to play in the cycle by which nutrients pass from the soil through plants and back to the soil. The slow removal of nutrients through leaching by rainwater is compensated by the steady release of minerals through the weathering of the underlying rock. Tree roots reach far down, bringing up water and nutrients from depths that non woody plants cannot reach. Also, their leaf fall can be used as a natural mulch to increase soil moisture as well as fertility.

These roles have been demonstrated practically in many research experiments. For example, Charreau and Vidal (1965) found the yield of pennisetum millet growing near *Fardhabia albida* 2-5 times more than the yield away from the tree and the protein yield of the crop 3.5 times greater than outside. This yield increase correlated with a several fold increase in soil nitrogen and organic matter. Nair (1984), Young (1986) and Sanchez (1987) have reviewed result from agroforestry system research in relation to soil productivity and species which have potential as soil improvers within agroforestry systems have been proposed (Young 1987; Nair 1984). One alley cropping study which monitors soil changes with time is that of leucaena intercropped with maize - cowpea rotation (annual) on sandy soil at lbadan, Nigeria (Kang et al 1981; 1985). Table I show soil condition, before and after hedgerow intercropping and compare the effects of retaining or removing pruning. The application of pruning led to higher SOM (soil organic matter), potassium, calcium and magnesium and improved available water holding capacity, but there was no change in phosphorus. SOM was maintained over the six years compared to a decline when pruning were removed.

These beneficial effects of trees have a potential for farming systems with both low and high inputs. In the absence of fertilizers, SOM maintenance supplies a reserve of balanced nutrients, progressively released by mineralization while recycling delays the necessity for fallowing.

Table 1: Soil changes under hedgerow intercropping (H.I) with leucaena, Ibadan, Nigeria. Values are for unfertilized plot, soil depth 0-15cm

Treatment	Exchangeable (Meg/100g) Bray P					
	PH	Org.C	K.	Ca	Mg	ppm
Before H.I	6.2	0.98	0.25	2.63	1.02	25
After 3 yrs H.I						
Pruning removed	5.7	0.96	0.16	5.07	0.35	19
After 6 yrs H.I						
Pruning removed	6.0	0.65	0.19	2.9	0.35	27
After 3 yrs H.I						
Pruning retained	5.7	1.47	0. 16	5.33	0.43	22
After 6 yrs H.I						
Pruning retained	6.0	1.07	0.28	3.45	0.50	26

Source: Kang et al 1981, 1985

ii Erosion control

Soil erosion is a serious threat to continued agricultural productivity. Erosion whether by wind or water leads to the loss of top soil where soil nutrients are concentrated thus leading to the disruption of agricultural production and degradation of the soil. This situation can however be halted by the provision of vegetation cover. Trees conserve the soil by protecting it from rain and wind, reducing soil erosion to a minimum. The canopy of trees shelters the ground from the impact of heavy downpours. The leaves drip water on the earth, giving it time to seep underground, bringing nourishment to animal and plant live beneath the tree.

Planting trees as windbreaks and shelterbelts can reduce the velocity of the wind to a speed that is insufficient to move soil particles. This can keep seeds and newly germinated seedlings from being blown away or dislodged, and can prevent ‘’sand – blast’’ damage to growing crops. The reduction in wind speed leads to lower evaporation from both open water and soil surfaces, making more water available for plant growth. The cumulative effect is that, after allowing for

the loss of cropping area planted to trees and the reduction in crop growth immediately next to the shelterbelt due to shading and competition for moisture and nutrients, crop production usually increases in the area protected by the shelterbelt. Research in China for instance has confirmed that shelterbelt eight to nine years old can reduce wind velocity and evaporation by about 30 and 18%, respectively, and increase soil moisture and atmospheric humidity by around 20 and 9%, respectively (World Bank, 1989). Besides the prime objective of stabilizing the soil, shelterbelts have resulted in increases in grain production ranging from 30 to 200% in Argentina, China, India, the Niger, Papua New Guinea and Tunisia (Hoskins, 1990).

However, the technology with greatest potential for erosion control are hedgerow intercropping (alley cropping) as has been demonstrated by the International Institute of Tropical Agriculture (IITA) (Table 2) at Ibadan, Nigeria.

Table 2: Erosion for alley cropping systems after 42mm rainfall in 1986

System	Soil Erosion kg/ha
No Till	Trace
Plowed	2,456
Alley cropping 4m spacing	
Leucaena	407
Gliricidia	77
Alley cropping, 2m spacing	
Leucaena	Trace
Gliricidia	6

Source IITA(1986)

iii. Maintenance of biodiversity

Biodiversity represents the wealth of live forms found on earth including millions of different plants, animals and micro-organisms and the genes they contain. Maintenance of this diversity is an insurance and investment necessary to sustain and improve agriculture. This is because it is the sources of all our food. Moreover, cross breeding of domestic crops with wild varieties can improve yields and produce new strains better adapted to growing conditions or more resistant to diseases and pests. In the United States for instance, crossbreeding main crops with fresh genetic characteristics (taken either from the wild or from primitive cultivated varieties) has yielded an estimated 1% annual increase in productivity worth more than U.S $ 1 billion (WWF and IUCN, undated). Between 1930 and 1975 for example, yields per hectare of wheat in the United States rose by 115%, rice by 117%, maize by 320%, sugar cane by 141% and cotton by 18%. About half of this increase was attributed to genetic improvement and breeding (FAO et al undated).

The major store house of this genetic diversity is the forest. The forest systems of the world – particularly tropical forests - house a great portion of the planets plant and animal species. No doubt, forest ecosystems are very important for both the maintenance and expansion of food production.

iv. Direct production of food.

The variety and importance of food that people especially in the rural areas obtain either directly from the forest, or produce in an environment sustained and protected by trees are enormous. In the whole of West Africa for instance, forests and trees provide food sources in a variety of forms which include edible leaves, fruits, seeds, nuts, roots, tubers, sap, bark, mushroom, honey, game, snails and insects. Trees are often the only reliable source of food for the family when crops fail or during the lean periods between harvests. Food from the forests are often used to help meet dietary shortfalls during particular seasons of the year, bridging “hunger periods” when stored food supplies are dwindling and the next harvest is not yet available. They are also valued during the peak agricultural labour periods when less time is available for cooking and people consume more snack foods. In addition, these products feature prominently during emergency periods such as floods, droughts, famine, wars, economic and social disasters when

nutrition, fuel for cooking and heating and timber for the reconstruction of homes and animal shelters become critical. In South Eastern Nigeria for example, the leaves of the forest trees such as *Pterocarpus spp, Gnetum africanum, Gongronema latifolium, Ceiba pentandra and Vitex doniana* are highly valued as vegetables because they flush during the dry season when cultivated vegetables are scarce. As well, African pear (*Dacryodes edulis*) and African star apple (*Chrysophyllum albidum*) provide off season food because they mature when cultivated staples such as rice, yam, cocoyam are yet to mature. In the sudan Sahelian parts of the country, baobab (*Adansonia digitata*) roots are consumed as a drought food (Aju and Uwalaka, 2010). Also, a very important source of food is wildlife which accounts for as much as 20-90% of the animal protein intake in the West Africa sub-region and in some communities, as much as 100%. (Ajayi, 1979). And finally, of very great significance is the fact that during almost any period of the year, there is a species or a tree that can produce something to eat.

v. Provision of farm inputs.

A vast variety and amounts of forest and tree products also support the major productive activities of farming including livestock production, fishing and hunting. A shortage of these products constrains the efficiency of crop production. Non- timber forest products (NTFPs) provide materials for supporting crops (e.g. yam and pumpkin stakes), as well as materials for making farm tools. In the Igbo speaking areas of Southeastern Nigeria for example hoe, axe, machete and digger handles, are made of materials taken from *Pentaclethra macrophylla* and *Dactyladenia guineense*. NTFPs also provide materials for making baskets used in carrying and marketing produce, racks for crop drying and storage (e.g., yam barns and maize cribs), pestle and mortars used for pounding the staple food, and sieves for crop processing (e.g., garri making). Fencing materials are also provided by NTFPs e.g., *Newbuldia laevis* and *Anthonatha macrophylla)* while ash resulting from burning vegetal matter is used not only as fertilizer but also as pesticide to protect field crops and stored products. In Igbo land, cola nuts are commonly stored in the leaves of *Onchocalamus* species while the leaves of *Marantochloa flexuosa* and *Thaumatococcus daneilli* are used to wrap and preserve several prepared foods such as agidi and moimoi. Fishing equipment (including dugout canoes made from particular tree species e.g.

Triplochiton scleroxylon and *Gossweilerodendron balsamiferum;* traps and ropes from *Raphia hookeri)* all derive from NTFPs (Okigbo, 1980; FAO 1990; Okali 1995).

vi. Fuel wood supply

Forest also provides fuel wood needed for the processing of farm produce. In West Africa for instance, fuel wood is the principal fuel used in the preservation and processing of food in many rural areas and this contributes to the stability of food supplies all year round because its extends food resources into a non-productive period. Although, the exact effects of fuel wood scarcity on diet is yet to be adequately researched, it is well known that cooking releases the nutrients in grains and fibrous foods, making them edible and appealing. Some classes of food, for example certain varieties of cassava and beans, can even be poisonous if not properly cooked. In this regard, therefore, wood for energy is essential if adequate food supplies are to be converted into adequate diets (Aju and Uwalaka, 2010). Fuel wood is also needed in such agricultural based industries as fish-smoking, tea and tobacco curing, bakeries, brick- making and pottery. Hence fuel wood shortages directly affect these industries and the level of employment and income generated by them. With the increase scarcity of fuel wood, families may be compelled to eat less nutritious quick-cooking foods - or even uncooked meals. This may seriously impair their health which would automatically translate into low agricultural production. In Peru for instance, Alcantra et al (1985) found that, in one study area, the consumption of half- cooked food was common and affected the nutritional status of families.

In Northern parts of the country, increasing scarcity of fuel wood in recent times has compelled many families to revert to the use of cow dung to provide energy and by so doing depriving the soil of the much needed organic mature with consequent decline in crop yield. Also, as fuel wood becomes increasingly scarce, people are forced to work longer distances to find new supplies thus spending much of their time in fuel wood collection and less in tending crops. A survey carried out in Abia State, Nigeria showed that women and their children now trek an average of two kilometers and spend an average of two hours a day to obtain supplies of fuel wood (Aju et al, 2006).

vii. As a source of fodder

Many species of trees in the tropics are used for fodder either for browse or stall feeding. Wickens et al (1985) estimate that 75% of the tree species (700-10,000) of tropical Africa are used as browse. Fodder trees contribute in several ways to the overall food security of households. They make a significant contribution to domestic livestock production which in turn influence milk and meat supply. For instance, for the 13,947,000 heads of cattle, 43,495,000 heads of goat and 22,204,000 heads of sheep that exist in Nigeria, 97% are said to be reared by the trans-humans system (FDF & FME, 1999). Hence, these animals depend on fodder trees for their food particularly during the dry season periods. In addition, fodder trees contribute to maintaining drought animals and producing manure for organic fertilizer thereby supporting agricultural production (FAO, 1989).

Fodder trees and shrubs have an important advantage over fodder grasses and herbaceous legumes; they can tap deep, underground moisture reserves when the upper soil layers have dried out. This means that trees can continue to produce fodder when grasses and annual crops have ceased to grow. Moreover, grass on drying loose much of its energy, protein, vitamin and mineral values hence animals have to depend on fodder from trees for their survival during the dry season (FAO, 1991). For instance, *Fardherbia albida,* an important fodder species in many regions of sahelian Africa accounts for as much as 30-45% of the total feed intake in this region during the dry season (FAO, 1989). Trees also give high protein fodder. A study in Ghana showed that the browse from trees and shrubs contains two to three time as much protein as the grasses available (FAO, 1991).

viii. Employment and income generation.

Forest also contributes indirectly to household food security, through the generation of employment and income from the sale and exchange of gathered and processed forest products. According to Aju and Uwalaka (2010), a wide range of forest products which rural people gather, produce and trade in order to derive income. These products include fuel wood, dyes, rattan, fibres, fruits, nuts, leaves, mushrooms, bamboo, medicines, gums, and forest game. In many countries, forestry – based activities are a major source of off-farm employment in rural

areas. According to Kilby and Liedholm (1986), small forest based gathering and processing enterprises provide one of the largest source of non-agricultural employment and income to rural people at a time when rural households have to look to non-farm employment and income for a growing share of their total livelihood. For example in Sierra Leone and Jamaica, forest – based, small – scale enterprises account for more than one - fifth and one – third of off-farm respectively, of total employment in the small-scale enterprise sector (FAO, 1985b). Kaimowitz, (2007), reported that between 15 – 30% of non - farm rural enterprises involve wood – based activities. Forest – based activities also accounts for a significant proportion of household income in many rural areas in Nigeria. A survey carried out in Imo state for instance revealed that forest and farm tree products accounted for 43% of household income among its farming communities (Aju, 1999). This income helps to supplement income from agricultural production as well as provide a relief source in times of seasonal and emergency food and cash shortages:

CONCLUSION

From the foregoing analysis, it is obvious that forestry and trees play a very important role in the sustainability of agricultural production and in the promotion of food security. And, this position can be further enhanced if deliberate attempts are made to initiate scientific approaches to tree growing on farmlands. To this end the recent growth of interest in agroforestry is a welcome development that needs to be sustained. This is because agroforestry as FAO (1985a) has noted offers the opportunity for agricultural and forestry staff to work together in innovative approaches to land use and in devising and promoting the stable, sustained, diversified and highly productive systems that are an essential foundation for food security. Therefore, instead of the false dichotomy that has existed between forestry and agriculture, expert from the two fields should team, up together in the effort to ensure food security.

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